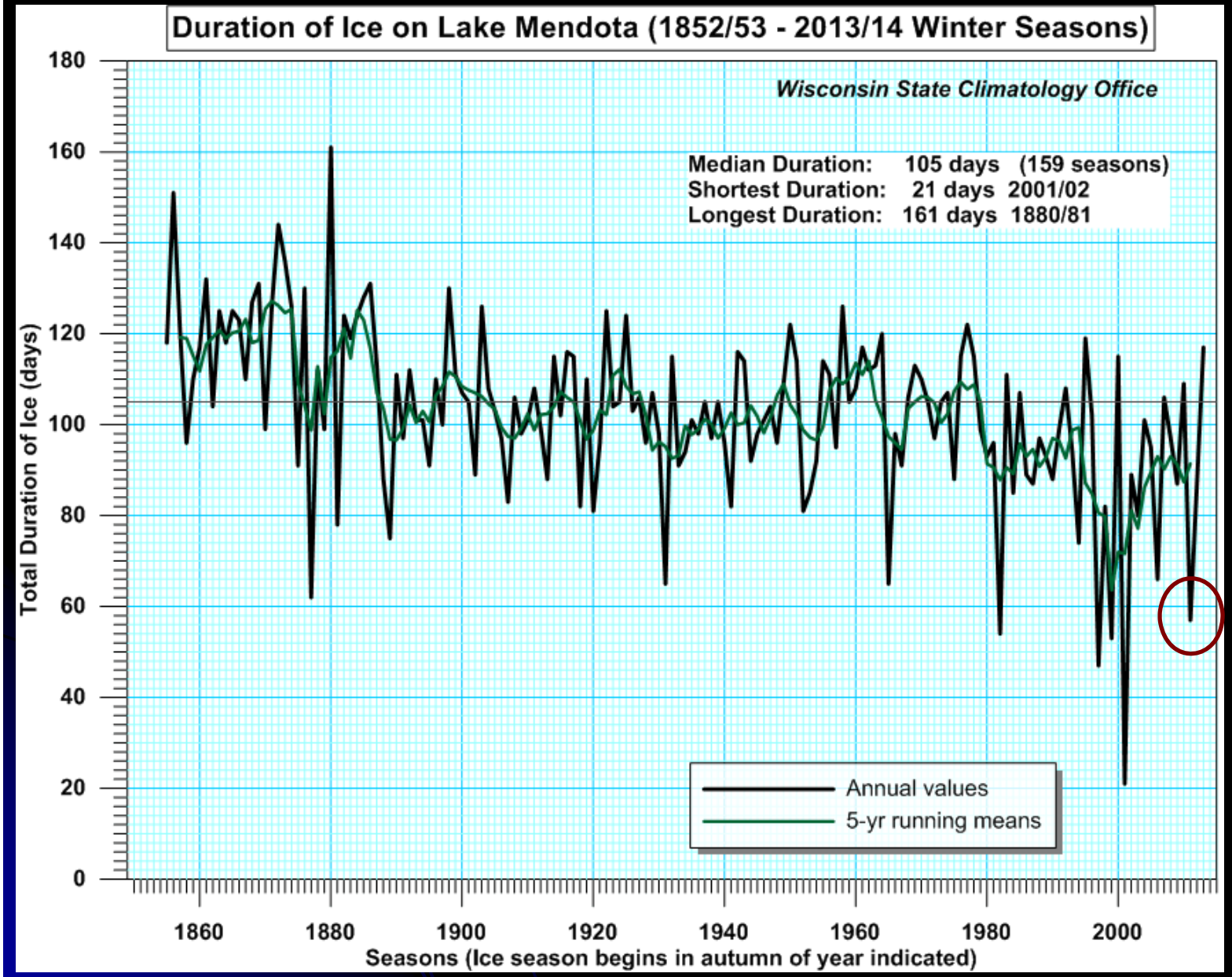
Adapting to Wisconsin's Changing Climate

Tim Asplund, WDNR Water Resource Monitoring Section
Water Program Rep., WICCI Science Advisory Board
Wisconsin Lakes Convention, April 25, 2014

One of many signs of warming in Wisconsin...

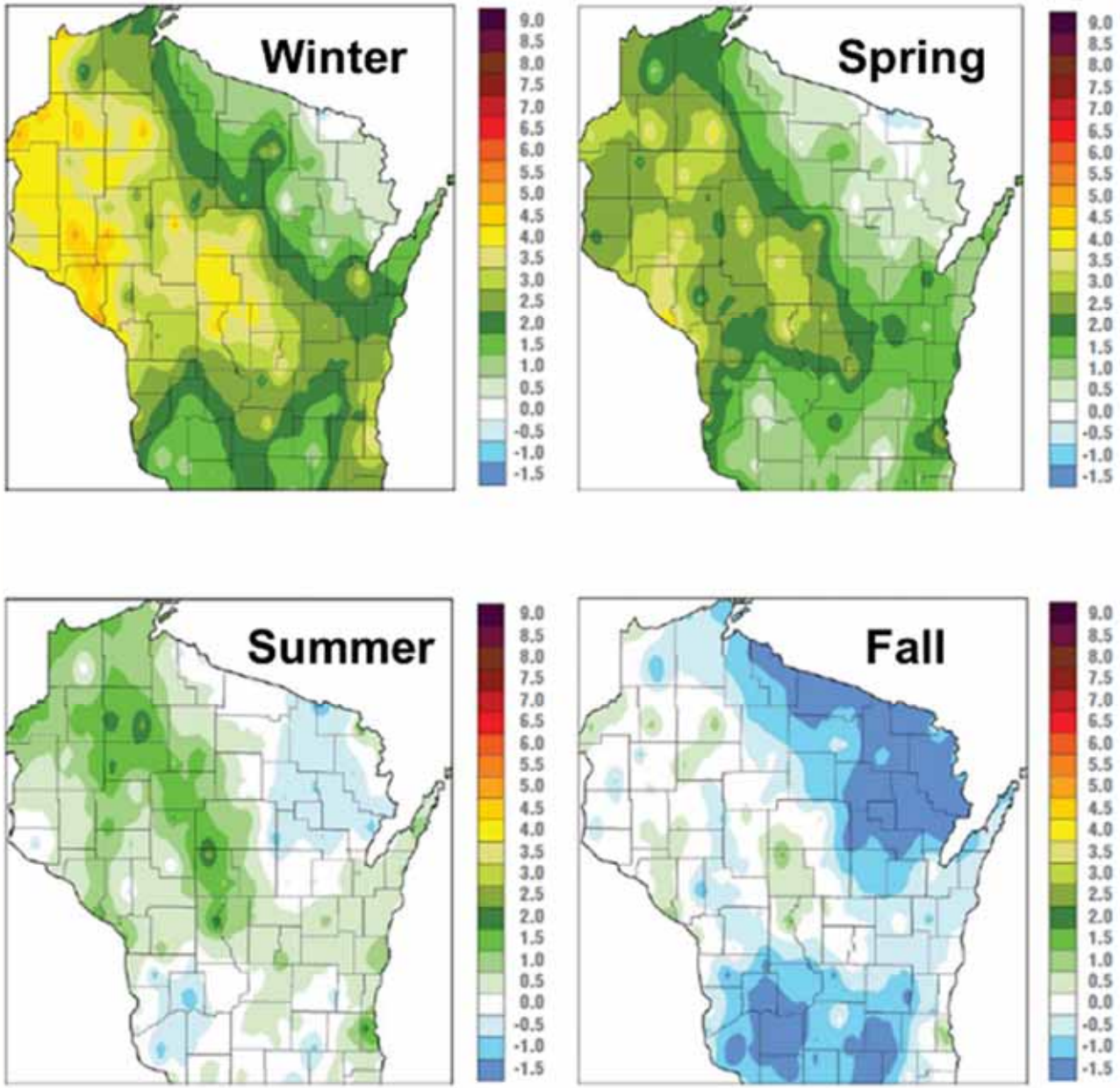


2014:
118 days
13 days above median

2012:
57 days
5th shortest

Observed Change in Average Temperatures

°F from 1950 to 2006



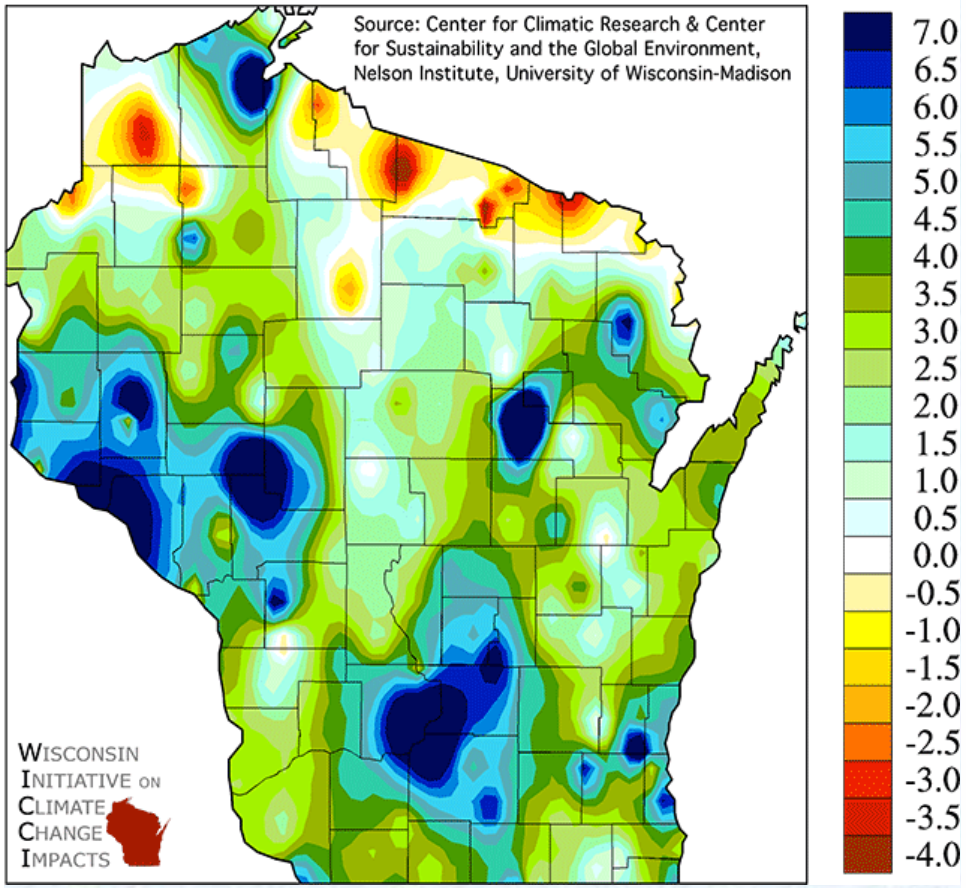
Winter temperatures have warmed more than any other season in recent decades, especially in northwestern Wisconsin.

(from Serbin and Kucharik 2009)

Summary of recent **historic** climate

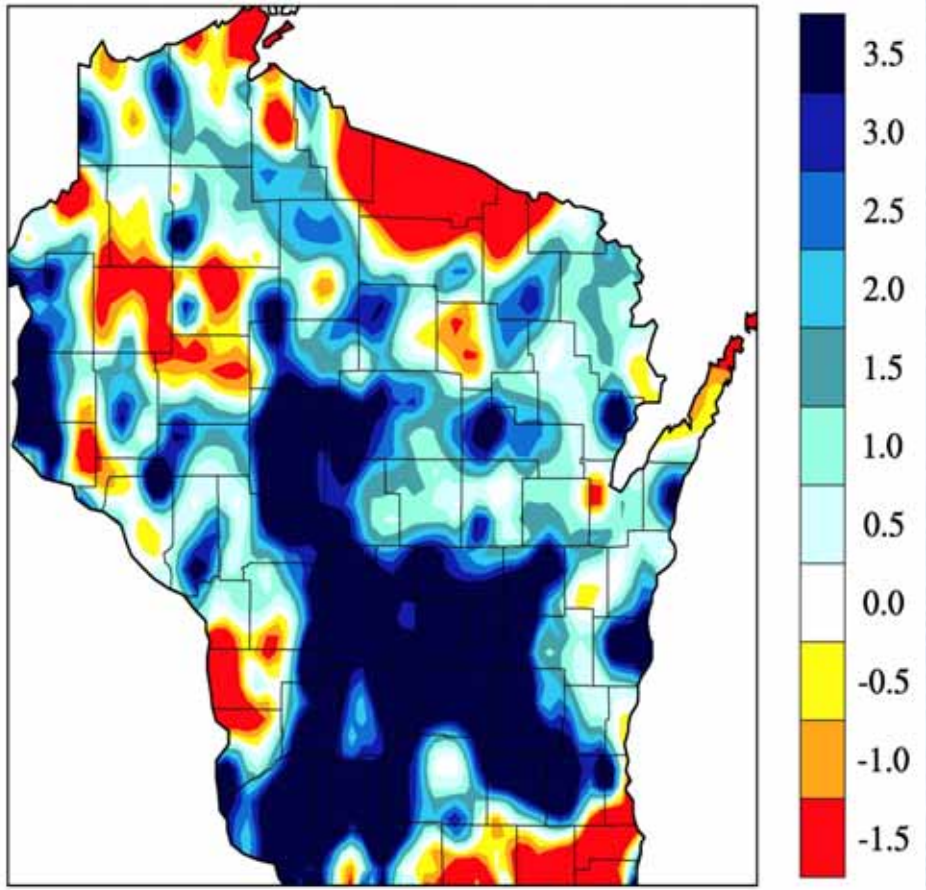
1950-2006 (based on NWS records)

Change in annual average precipitation (inches) 1950 to 2006



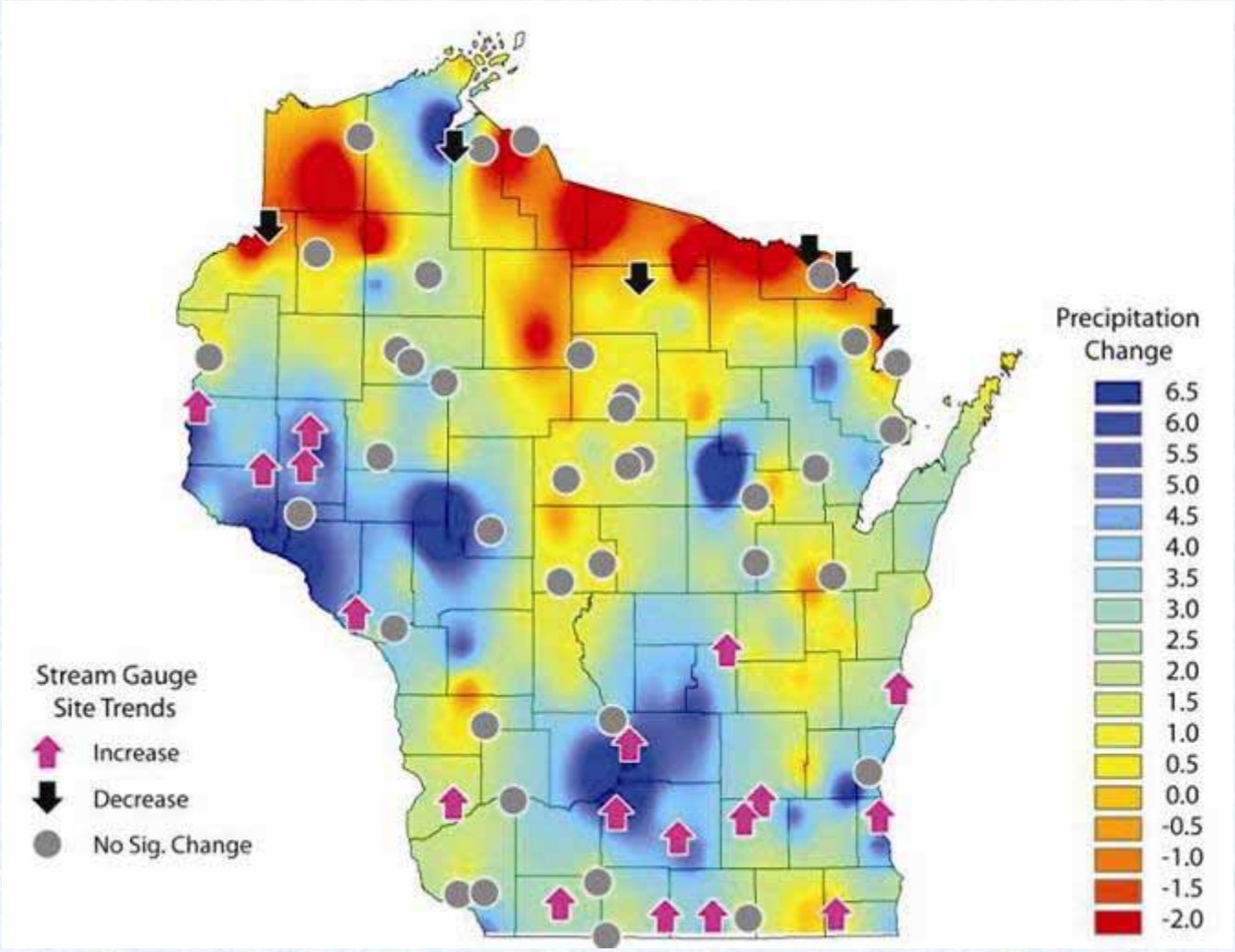
↑7” to ↓4” (drought)

Increase in 2” rainfalls (days/decade) 1950 to 2006



↑3.5 days to ↓1.5 days
(regionally variable)

Annual Stream Flow Trends and Precipitation Change from 1950 to 2006

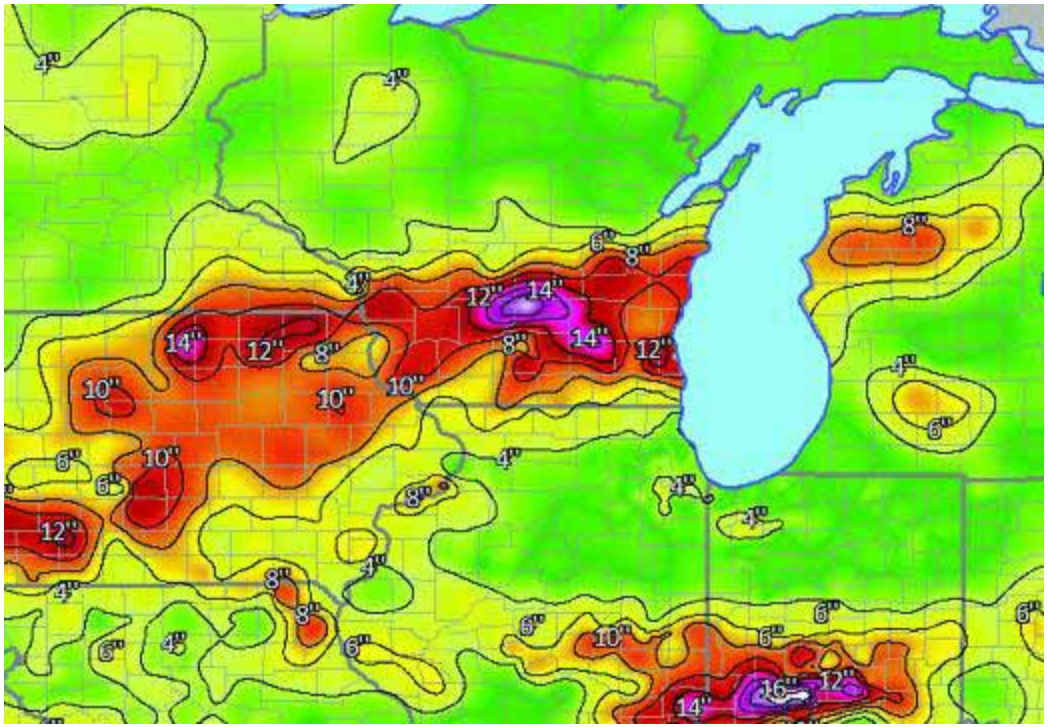


Trends in observed stream flows generally corresponded to changes in precipitation across Wisconsin.

Source: Greb et al., WICCI Water Resources & Climate Working Groups

Extreme events: June 2008 storms

Total Precipitation (inches), June 1-15, 2008

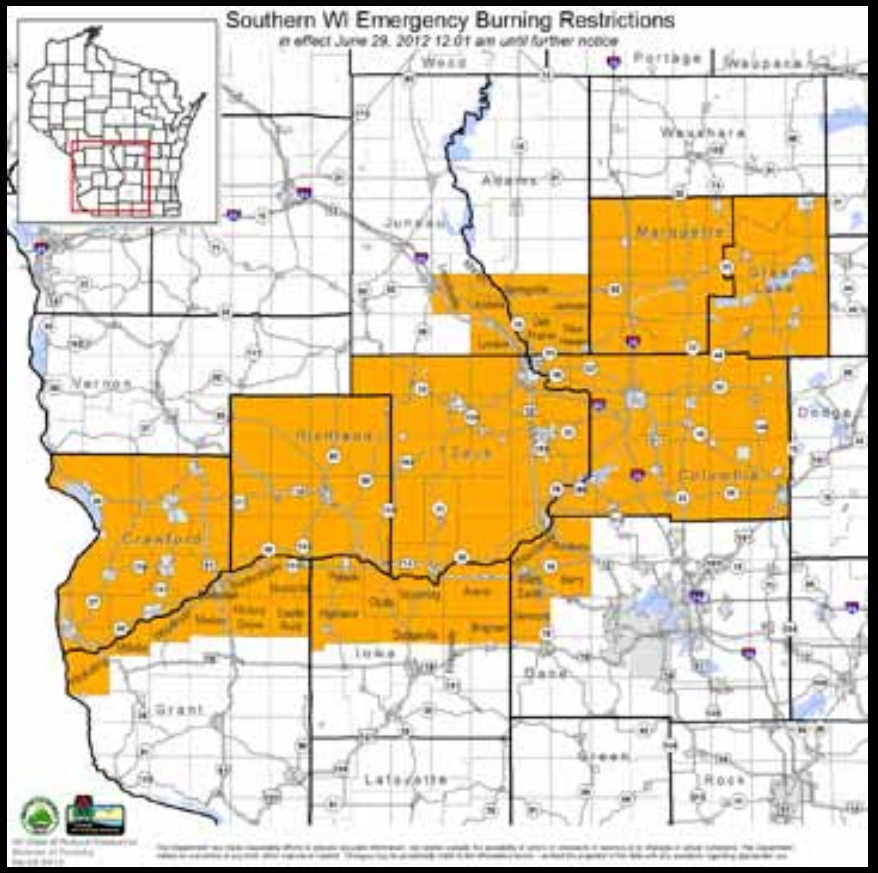


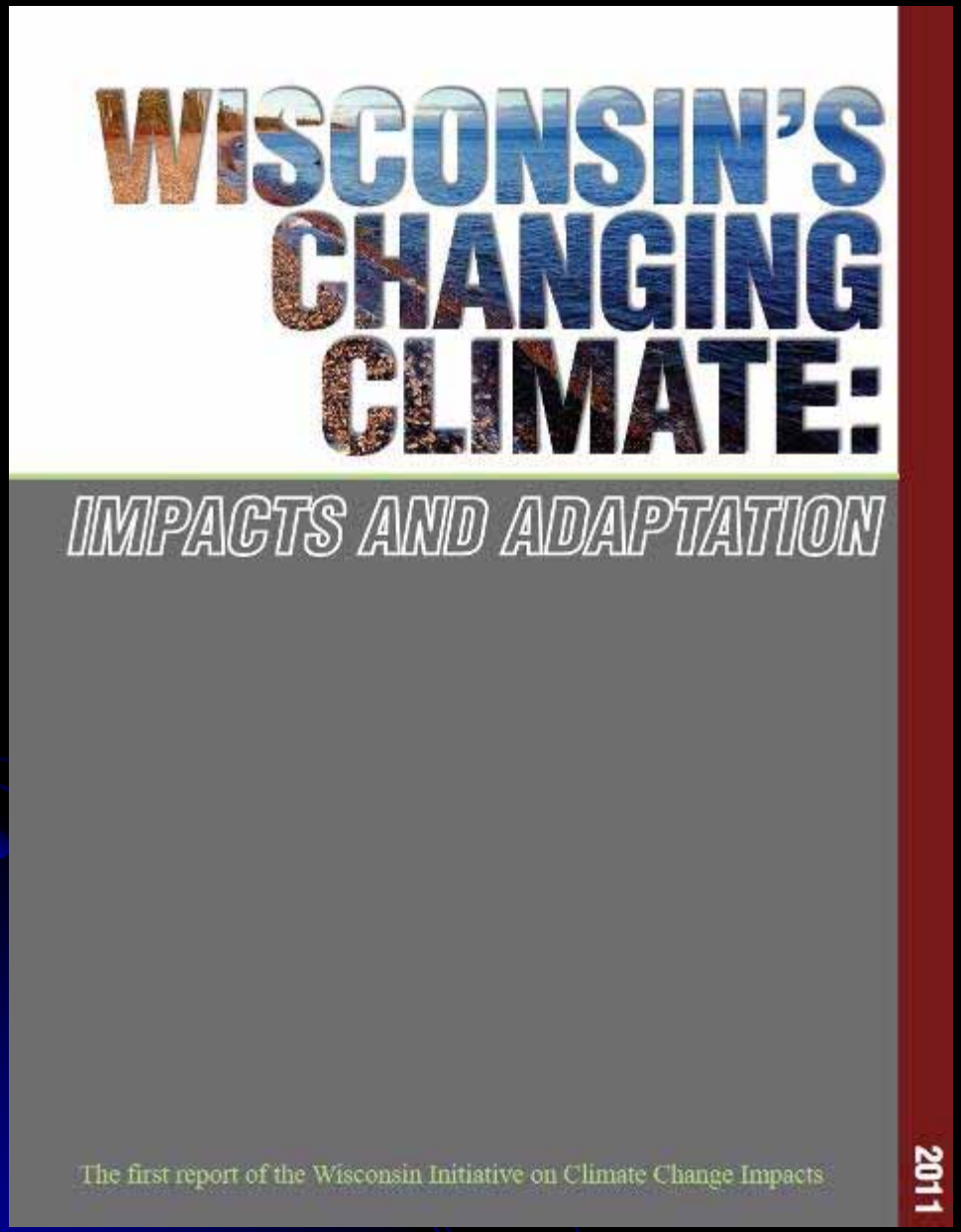
- Stormwater infrastructure was overwhelmed
- Massive flooding (810 sq. mi)
- Water from private wells contaminated (28%)
- Raw sewage overflows (90 million gallons from 161 wastewater treatment plants)
- FEMA paid $34 million in flood damage claims

Few communities even today can handle these kinds of extreme events!

Minnesota Public Radio

Flooding in Duluth-Superior, June 2012


Southern WI Emergency Burning Restrictions
in effect June 29, 2012 12:01 am until further notice
Vernon
Crawford
Richland
Iowa
Grant
Lafayette
Sauk
Columbia
Dane
Green
Rock
Dodge
Marquette
Adams
Juneau
Wood
Portage
Waupaca
Waushara



WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

WICCI's First Adaptive Assessment Report - released Feb 2011

30+ Authors

10 Editorial Team Members

22 Science Council Members

22 Chairs/Co-Chairs of 15 Working Groups

220 Working Group Members

http://wicci.wisc.edu

WICCI's Mission


A.B. Sheldon


WDNR

- Assess and anticipate climate change impacts on specific Wisconsin natural resources, ecosystems and regions
- Evaluate potential effects on industry, agriculture, tourism, and other human activities
- Develop and recommend adaptation strategies

WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

Adaptation – What is it?

IPCC "… adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities."

Pew Center 2011: "Actions taken by individuals or systems to avoid, withstand, or take advantage of current and projected climate changes and impacts. Adaptation decreases a system's vulnerability or increases its resilience to impacts".

WICCI: How humans will respond to climate change in a way that will make our natural and human systems more resilient.

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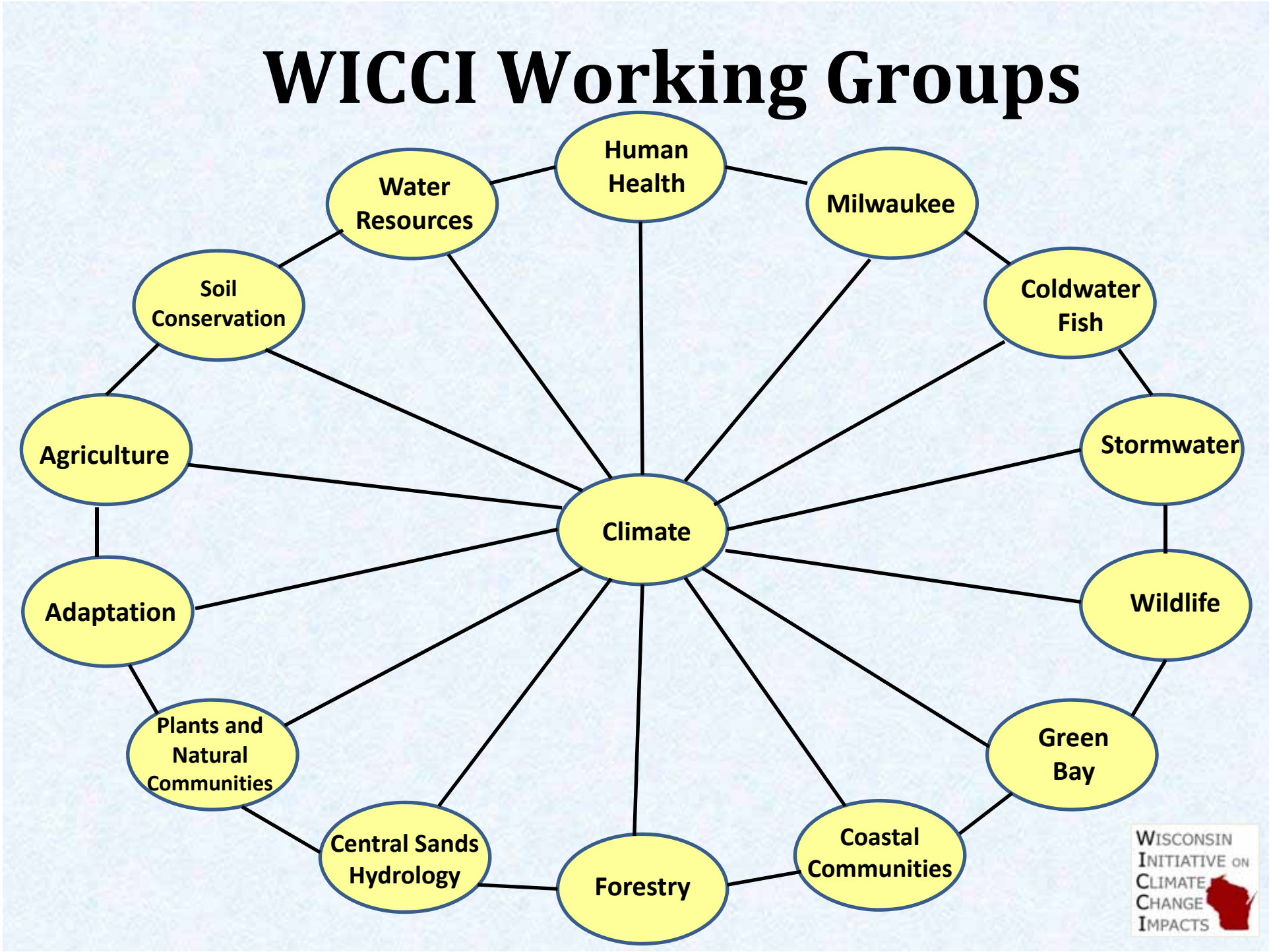
Photo: John Magnuson

WICCI Working Groups

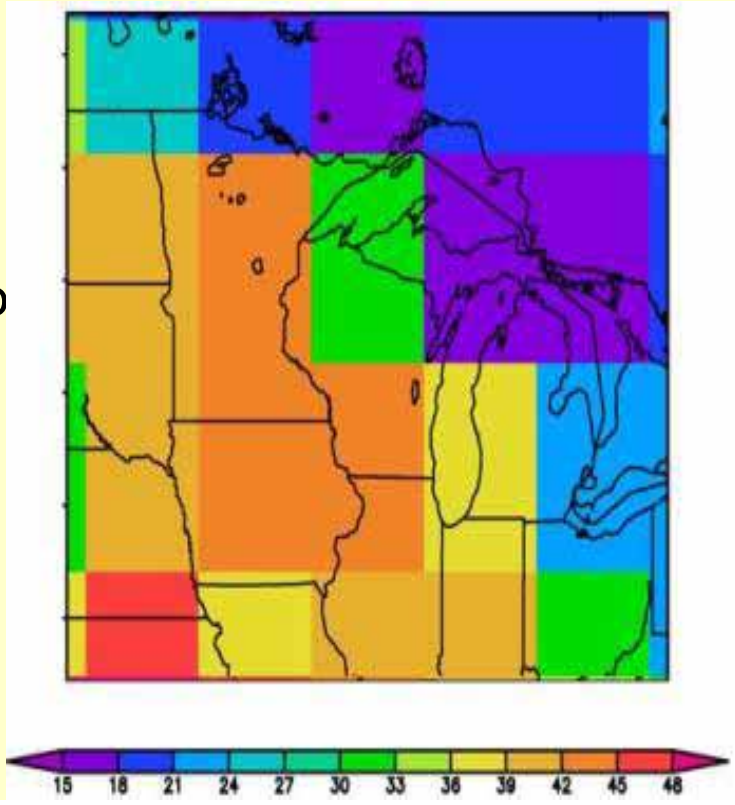


WICCI Climate Working Group

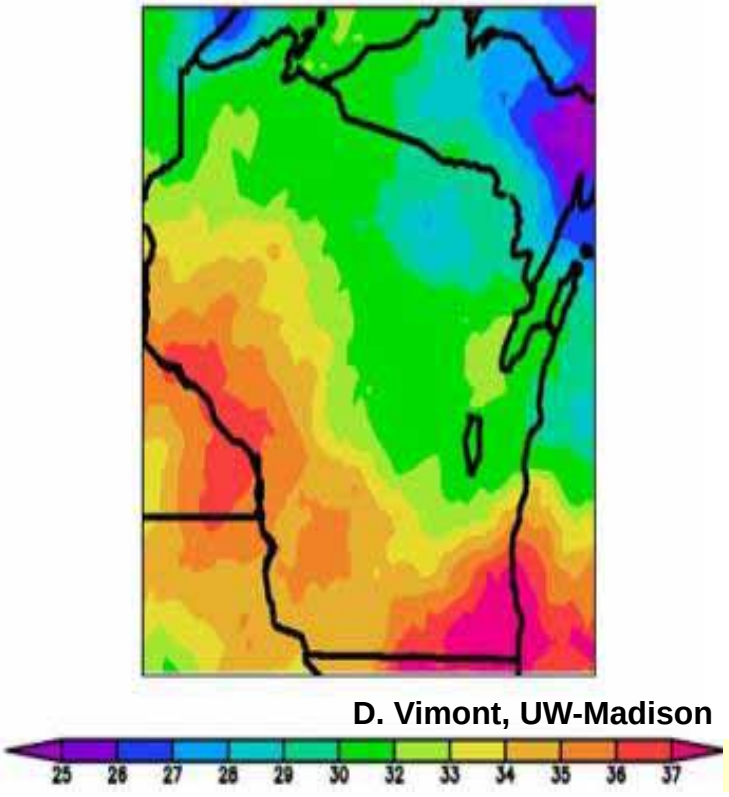
- Used 14 General Circulation Models (GCM's) from IPCC 2007 assessment
- Verified using historical Wisconsin weather station data
- Result: a statistical range of probable climate change

Downscaling: Focus global projections to a scale relevant to climate impacts in Wisconsin

GCM grid



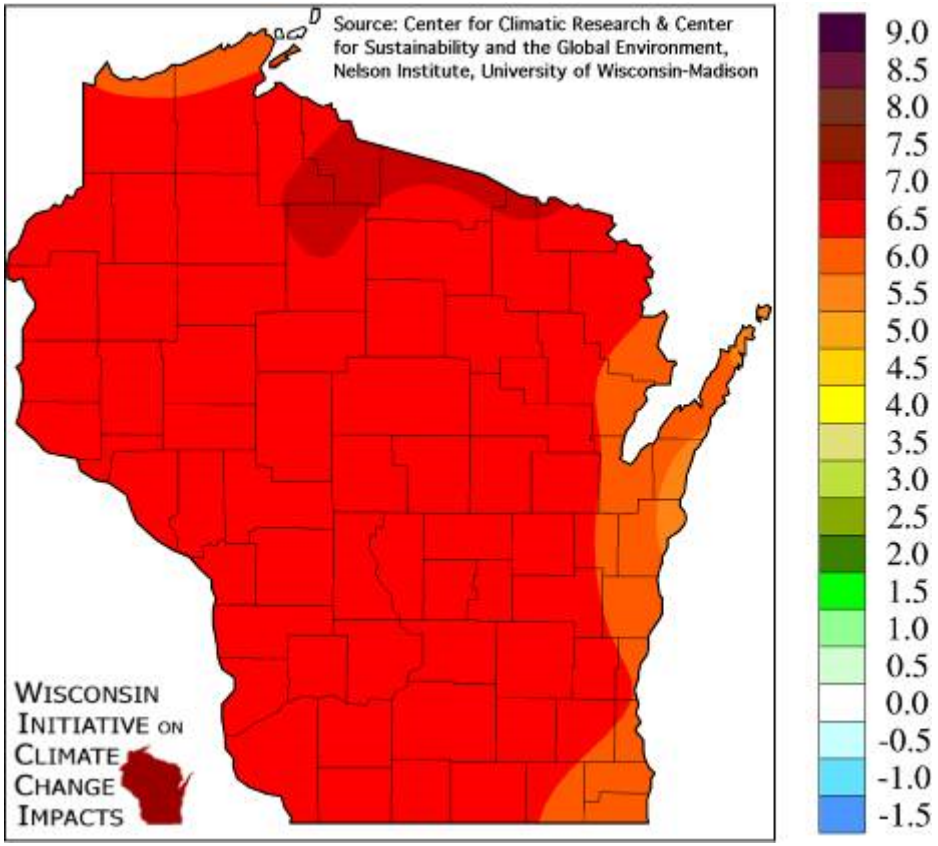
Downscaled (8x8 km) grid



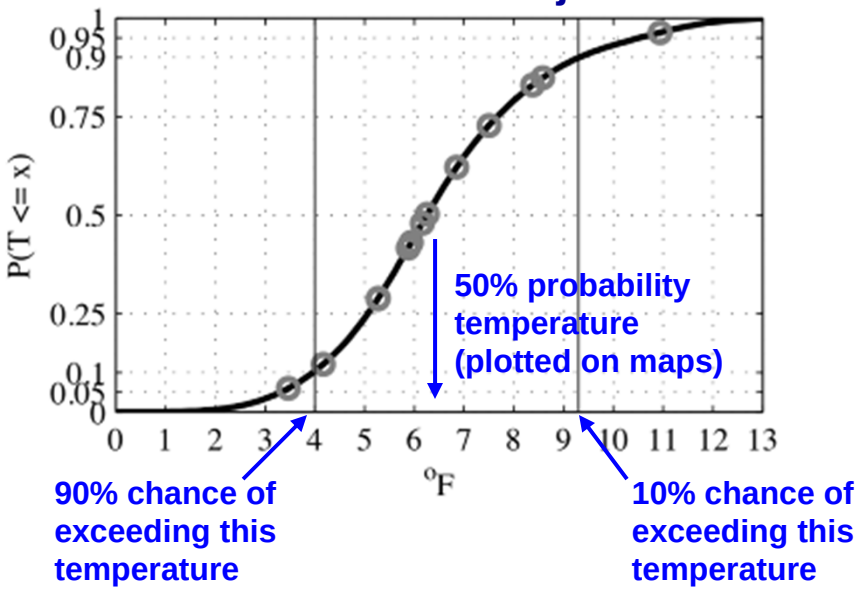
D. Vimont, UW-Madison

Annual Temperature Change

Projected Change in Annual Average Temperature (°F) from 1980 to 2055



Probability Distribution of 14 Global Climate Model Projections



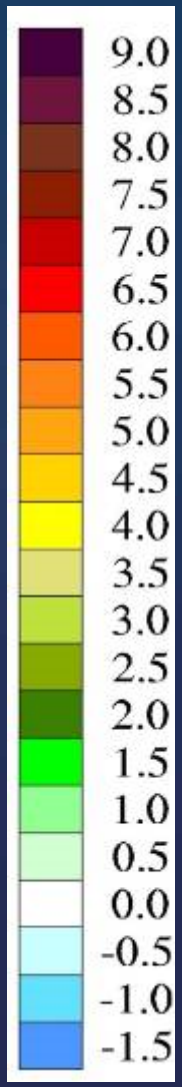
Wisconsin will warm by 4 – 9 °F by mid-21st Century

Source: Adapted from D. Vimont, UW-Madison

Projected Change in Seasonal Temperatures
1980 to 2055 (°F)

Winter

Spring



More "very hot" days..... fewer "very cold" nights

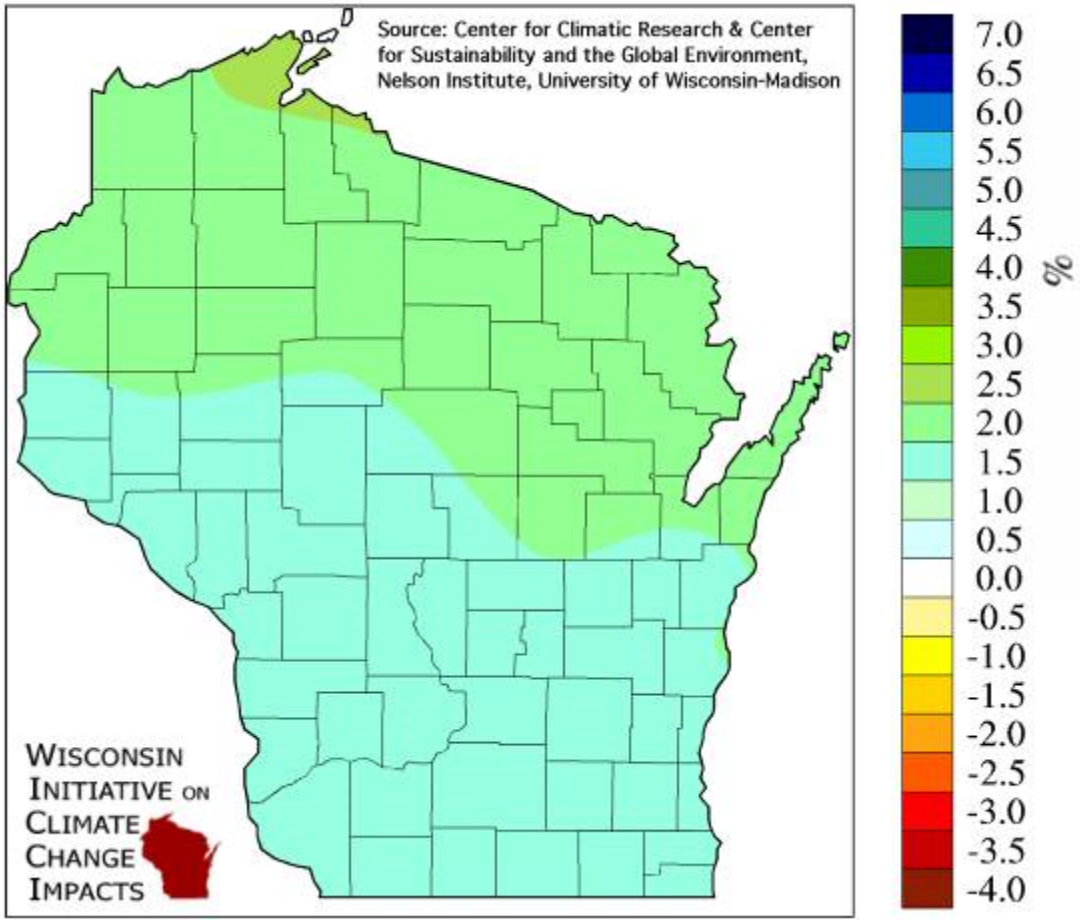
Summer

Fall

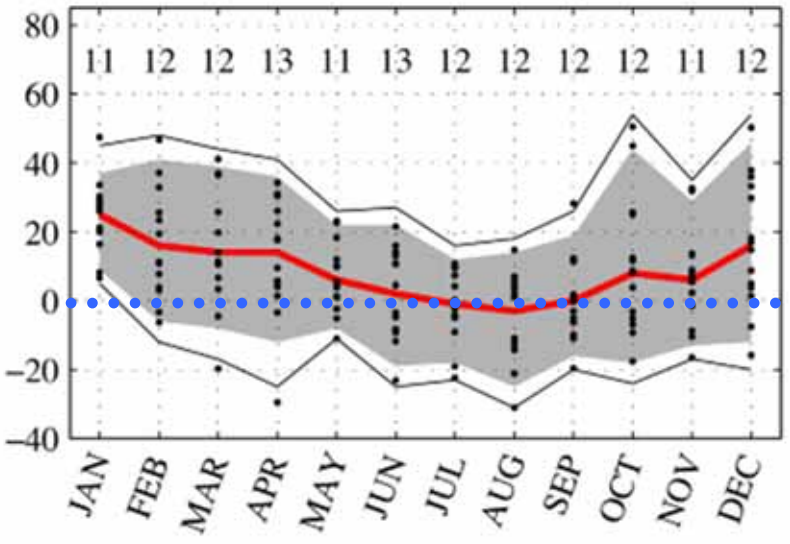
Wisconsin Initiative on Climate Change Impacts

Projected Change in Precipitation from 1980 to 2055

Change in Annual Average (inches)



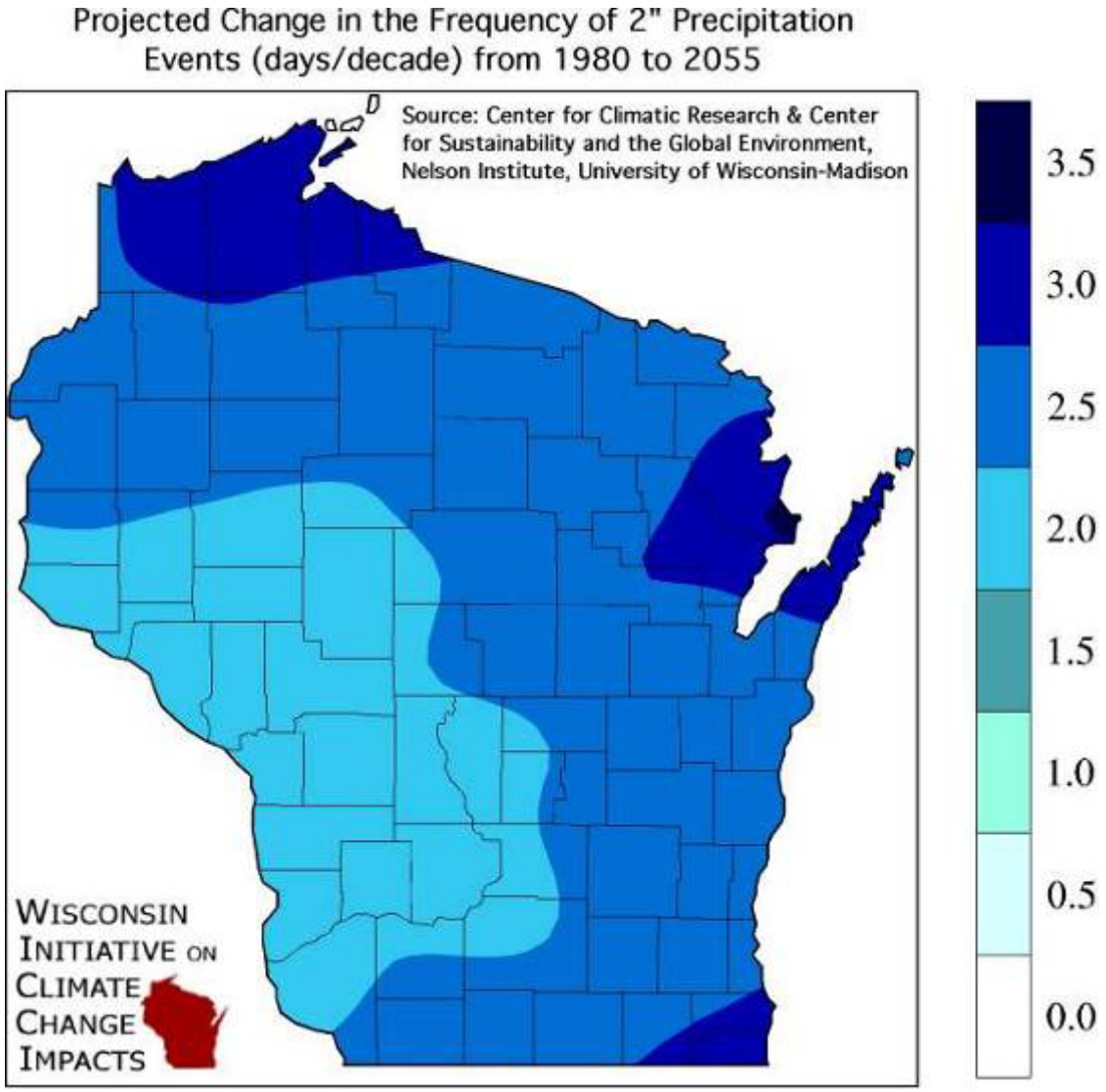
Probability Distributions of 14 Climate Model Projections by Month



Models predict winter and early spring will be wetter (0-40% increase).

Models uncertain about amount of summer rainfall

Number of days with intense precipitation is projected to increase across Wisconsin in 21st century.



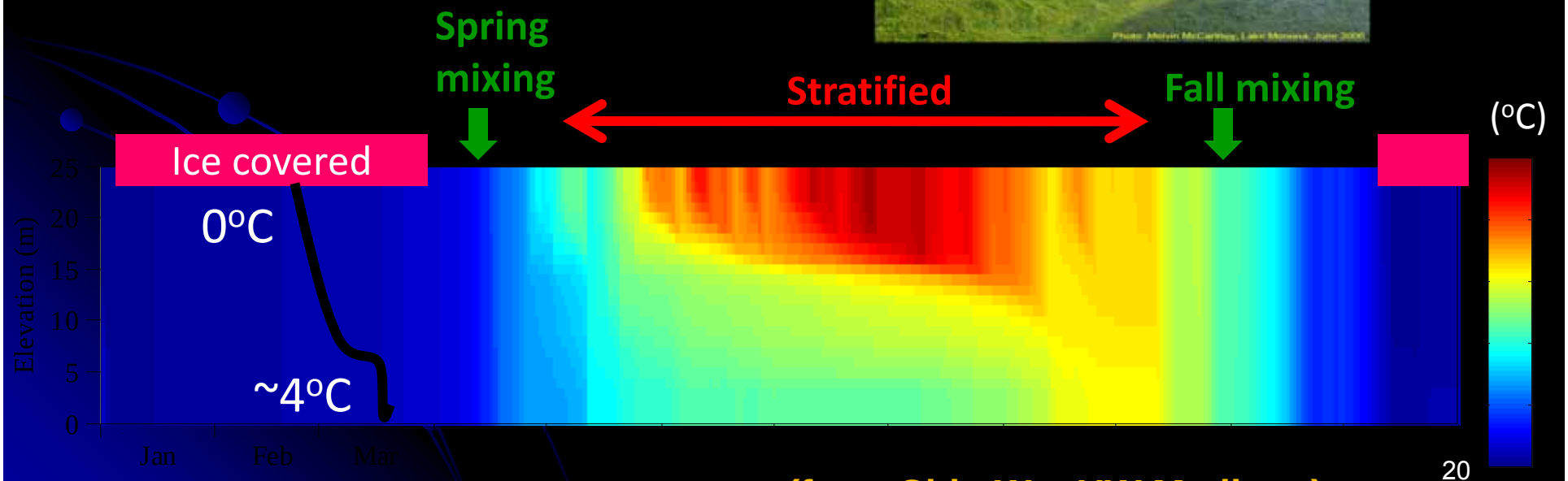
- Roughly a 25% increase in frequency.
- Recurrence intervals decrease from once every 10 months to once every 8 months in southern Wisconsin
- Once every 17 months to once every 14 months in northern Wisconsin.

Major Drivers of Climate Change Impacts on Water Resources

- Thermal Impacts (Increased air and water temps, longer ice-free period, more ET)
- Changing rainfall patterns (seasonal and spatial variability, + or – water, less precip in the form of snow)
- Increased storm intensity (more frequent large precipitation events)

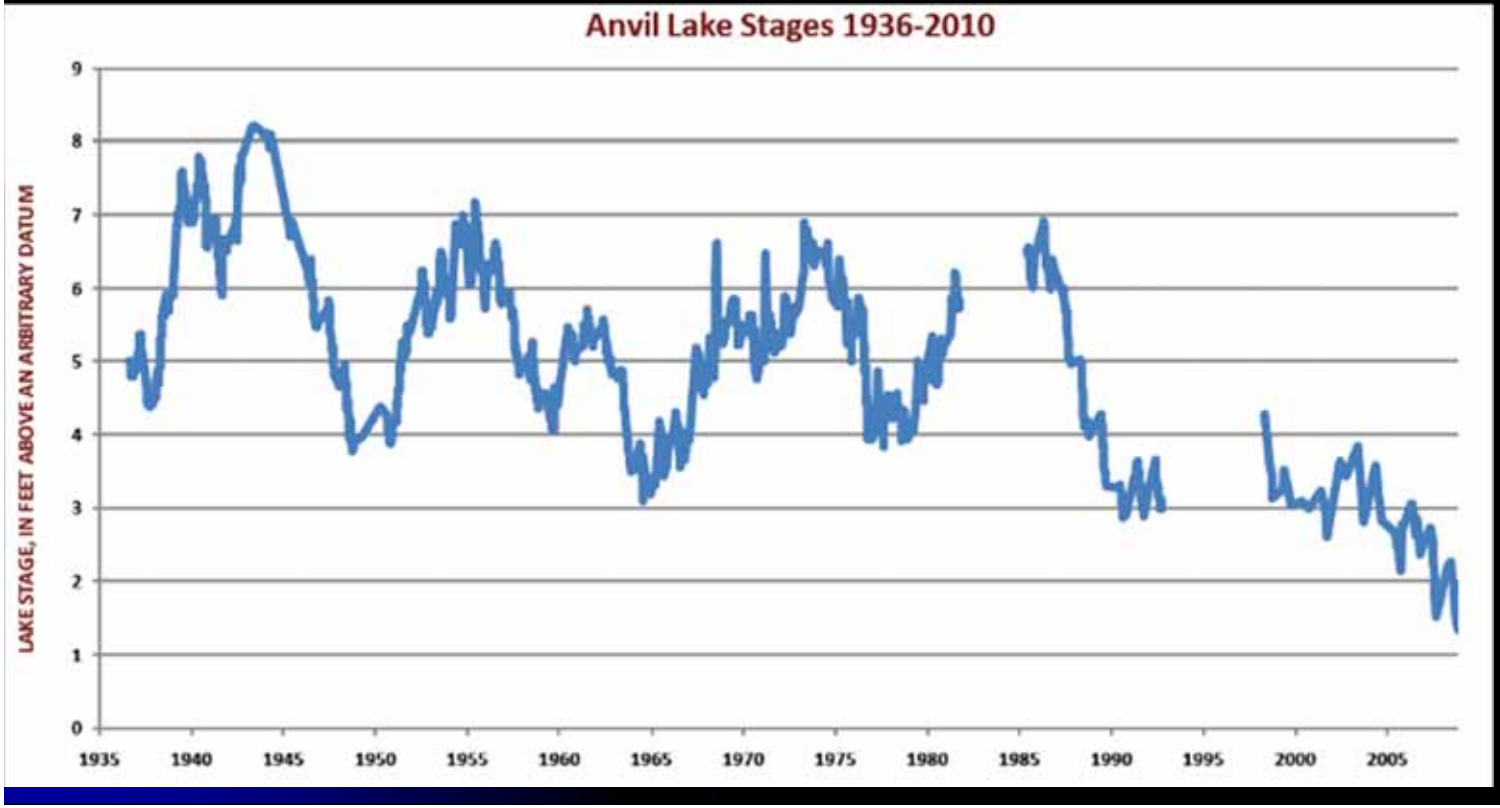
Changing Thermal Structure

- ✓ **Earlier** thermocline onset
- ✓ **Warmer** surface temp
- ✓ **Greater** temp gradient across thermocline
- ✓ **Longer** stratified period



(from Chin Wu, UW Madison)

Water loss through evapo-transpiration associated with warmer temperatures could exacerbate recurring drought effects in the future, especially in lakes and wetland systems high in the landscape.



WICCI Water Resources Working Group

R. Lathrop

Fallison Lake, Vilas County

Photo: http://photogallery.nrcs.usda.gov/

Photo: R. Lathrop

Photo: R. Lathrop

Warmer temperatures and increased runoff from large storm events causes water quality problems, blue-green toxins, eutrophication, etc

Photo: Melvin McCartney, Lake Monona, June 2006

Buildings, roads and water/sewer systems are not currently designed for challenges from future climate changes.

WICCI Stormwater Working Group


Photo: Michael Kienitz


Photo: Steve Zibell

WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

Key Water Resource Impacts

- ***Increased flooding***
- ***Increased frequency of harmful blue-green algal blooms***
- ***Conflicting water use concerns***
- ***Changes in water levels***
- ***Increased sediment and nutrient loading***
- ***Increased spread of aquatic invasive species***

Exacerbation of Existing Water Resource Problems

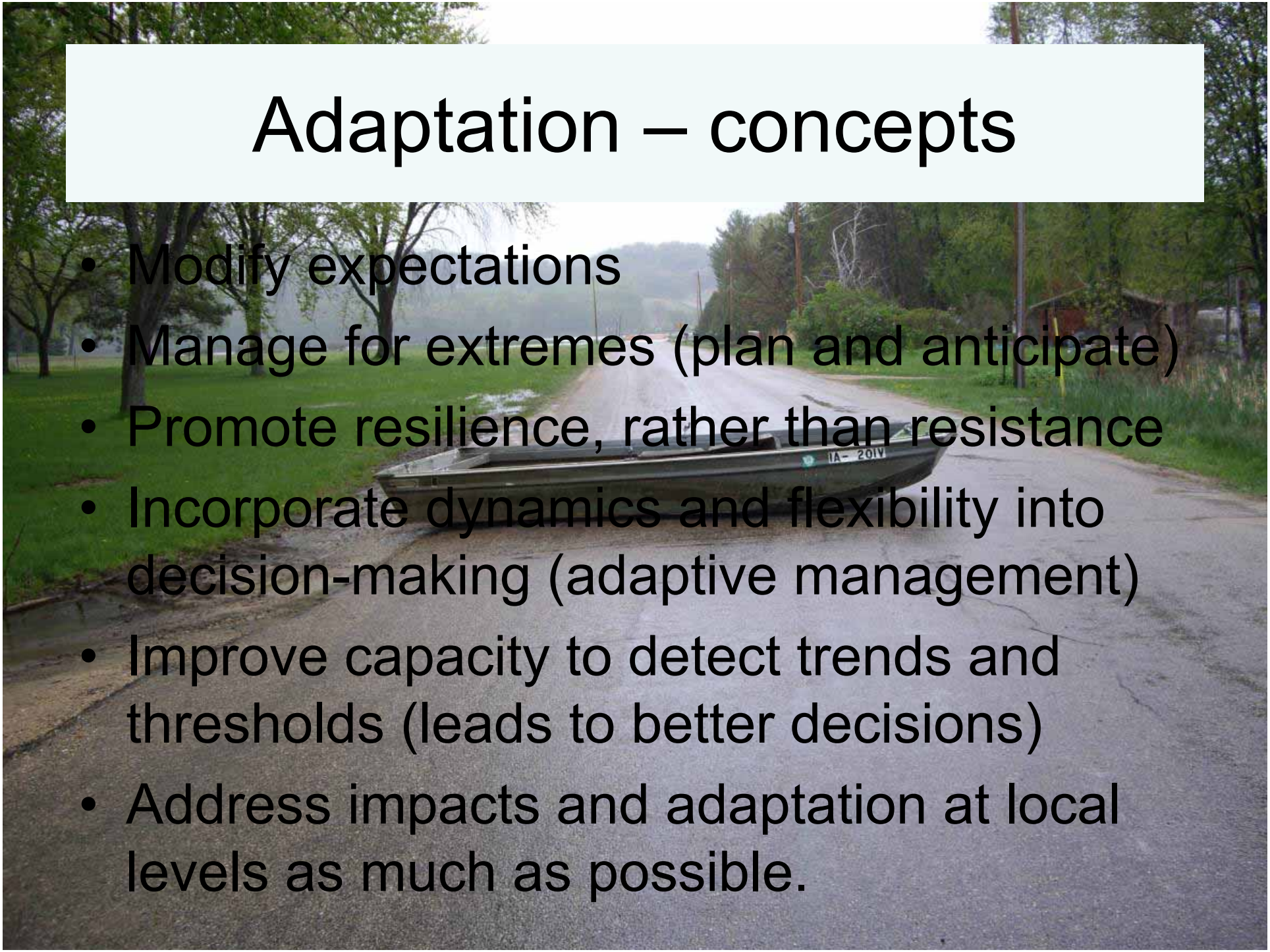
- Degradation of flood-absorbing capacity of wetlands, increased flooding and erosion
- Pressure to increase water extraction from the Great Lakes
- Mining of deep aquifers increases pressure on shallow groundwater
- ***More reliance on irrigation to grow crops***

WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

Areas of uncertainty

- Timing, amount, and form of spring precipitation events relative to spring thaw
- Balance between increased precipitation and increased evapotranspiration on groundwater recharge, and subsequently lake levels and stream baseflows
- Short term (years to decades) vs long term (decades to century) processes

Adaptation – concepts



- Modify expectations
- Manage for extremes (plan and anticipate)
- Promote resilience, rather than resistance
- Incorporate dynamics and flexibility into decision-making (adaptive management)
- Improve capacity to detect trends and thresholds (leads to better decisions)
- Address impacts and adaptation at local levels as much as possible.

Adaptation Goals:
From WDNR Water Division's Climate Change Strategy

Protect public health by anticipating and managing for extreme events, including floods and drought

Increase resiliency of aquatic ecosystems to buffer the impacts of climate change by restoring or simulating natural processes, ensuring adequate habitat availability, and limiting impacts of human health

Stabilize future variations in water quantity and availability by managing water as an integrated resources (by keeping water local) and supporting sustainable & efficient water use

Maintain, improve or restore water quality by promoting actions to reduce nutrient and sediment loading

WISCONSIN
DEPT. OF NATURAL RESOURCES

Impact: Sediment and nutrient loading will increase due to earlier and more intense spring runoff events

Adaptation Strategies:

- Resize infrastructure such as manure storage facilities to accommodate increased precipitation
- Restore wetlands to provide storage and filtration
- Promote the use of nutrient management planning
- Reduce overland flow by improving infiltration

Herb Garm

Carolyn Betz

Impact: Water levels will change due to variable precipitation, recharge, and increased evaporation

Adaptation Strategies:

- Enhance and restore shoreline habitat to withstand variations in water levels
- Enhance infiltration by reducing impervious surfaces in urban/riparian areas and changing land management practices
- Build flexibility into planning and zoning for lakeshore and riparian development to account for changes in water levels
- Adjust and modify expectations – variability is the norm!

Photo - WDNR

Photo – Janesville Gazette

Impact: Demand for water and groundwater will increase with warmer temperatures

Adaptation Strategies:

- Encourage large water users to locate in areas with adequate (sustainable) water sources (e.g. large rivers/Great Lakes).
- Encourage water conservation (rural and urban) through incentives and regulation
- Promote Integrated Water Management: Planning water use based on long term projections of supply and demand

Photo - Mark Rozin/Capital Press

Impact: Harmful blue-green algal blooms will occur more frequently with increased summer temperatures

Adaptation Strategies:

- Identify ways in which climate change processes may increase the occurrence of exposures to HABs
- Create a HAB surveillance program to improve predictive capacity
- Develop statewide standards for blue-green algal toxins and take appropriate action to protect public health.

Anvil Lake Association

Carolyn Betz

Impact: Aquatic invasive species are likely to spread due to flooding and warmer temperatures

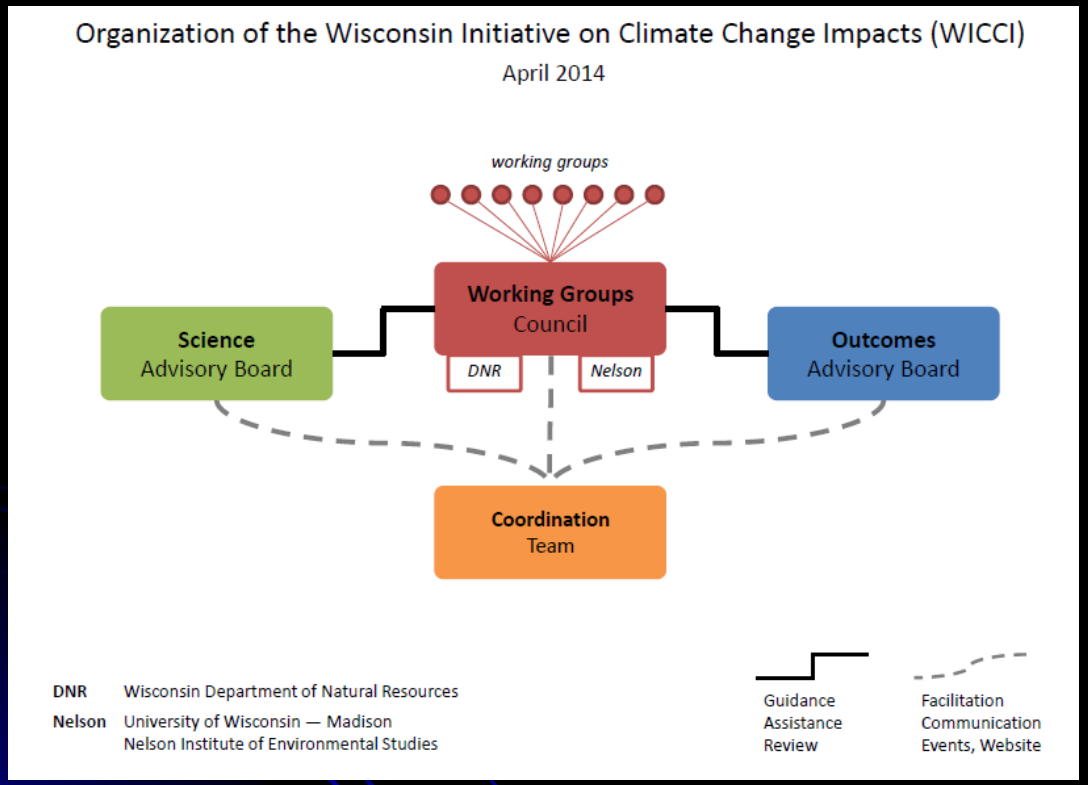
Adaptation Strategies:

- Identify potential pathways for invasive species migrations and take preventive action
- Encourage regulatory activities aimed at preventing future invasions of exotic and invasive species
- Continue exotic and invasive species education/awareness programs for boaters, anglers, and others
- Develop rapid response planning and implementation methods to improve existing aquatic invasive species control programs

Photo – WDNR

Photo – Don Bush, WDNR

WICCI Phase 2



Focus Areas:

Seepage Lakes
Thermal Impacts
Cold Water Fisheries
Biotic responses
Monitoring strategies
AIS distribution patterns

http://www.wicci.wisc.edu/